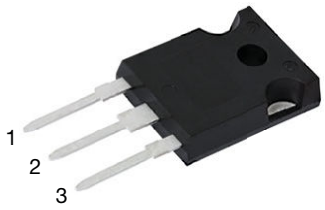
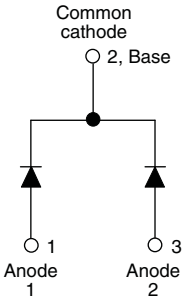
# HEXFRED®
# Ultrafast Soft Recovery Diode, 2 x 8 A




**TO-247AC 3L**




## FEATURES

- Ultrafast and ultrasoft recovery
- Very low $I_{RRM}$ and $Q_{rr}$
- Designed and qualified according to JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT
HALOGEN FREE

## BENEFITS

- Reduced RFI and EMI
- Reduced power loss in diode and switching transistor
- Higher frequency operation
- Reduced snubbing
- Reduced parts count

## DESCRIPTION

VS-HFA16PA60C... is a state of the art center tap ultrafast recovery diode. Employing the latest in epitaxial construction and advanced processing techniques it features a superb combination of characteristics which result in performance which is unsurpassed by any rectifier previously available. With basic ratings of 600 V and 8 A per leg continuous current, the VS-HFA16PA60C... is especially well suited for use as the companion diode for IGBTs and MOSFETs. In addition to ultrafast recovery time, the HEXFRED® product line features extremely low values of peak recovery current ($I_{RRM}$) and does not exhibit any tendency to "snap-off" during the $t_b$ portion of recovery. The HEXFRED features combine to offer designers a rectifier with lower noise and significantly lower switching losses in both the diode and the switching transistor. These HEXFRED advantages can help to significantly reduce snubbing, component count and heatsink sizes. The HEXFRED VS-HFA16PA60C... is ideally suited for applications in power supplies and power conversion systems (such as inverters), motor drives, and many other similar applications where high speed, high efficiency is needed.

| PRIMARY CHARACTERISTICS | |
|---|---|
| $I_{F(AV)}$ | 2 x 8 A |
| $V_R$ | 600 V |
| $V_F$ at $I_F$ | 1.4 V |
| $t_{rr}$ typ. | 18 ns |
| $T_J$ max. | 150 °C |
| Package | TO-247AC 3L |
| Circuit configuration | Common cathode |

| ABSOLUTE MAXIMUM RATINGS | | | | | |
|---|---|---|---|---|---|
| PARAMETER | | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Cathode to anode voltage | | $V_R$ | | 600 | V |
| Maximum continuous forward current | per leg | $I_F$ | $T_C$ = 100 °C | 8 | A |
| | per device | | | 16 | |
| Single pulse forward current | | $I_{FSM}$ | $t_p$ = 10 ms | 60 | |
| Maximum repetitive forward current | | $I_{FRM}$ | | 24 | |
| Maximum power dissipation | | $P_D$ | $T_C$ = 25 °C | 36 | W |
| | | | $T_C$ = 100 °C | 14 | |
| Operating junction and storage temperature range | | $T_J$, $T_{Stg}$ | | -55 to +150 | °C |

| ELECTRICAL SPECIFICATIONS PER LEG ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Cathode to anode breakdown voltage | $V_{BR}$ | $I_R$ = 100 µA | | 600 | - | - | V |
| Maximum forward voltage | $V_{FM}$ | $I_F$ = 8.0 A | See fig. 1 | - | 1.4 | 1.7 | |
| | | $I_F$ = 16 A | | - | 1.7 | 2.1 | |
| | | $I_F$ = 8.0 A, $T_J$ = 125 °C | | - | 1.4 | 1.7 | |
| Maximum reverse leakage current | $I_{RM}$ | $V_R$ = $V_R$ rated | See fig. 2 | - | 0.3 | 5.0 | µA |
| | | $T_J$ = 125 °C, $V_R$ = 0.8 x $V_R$ rated | | - | 100 | 500 | |
| Junction capacitance | $C_T$ | $V_R$ = 200 V | See fig. 3 | - | 10 | 25 | pF |
| Series inductance | $L_S$ | Measured lead to lead 5 mm from package body | | - | 8.0 | - | nH |

| DYNAMIC RECOVERY CHARACTERISTICS PER LEG ($T_J$ = 25 °C unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Reverse recovery time See fig. 5, 6 and 16 | $t_{rr}$ | $I_F$ = 1.0 A, $dI_F/dt$ = 200 A/µs, $V_R$ = 30 V | | - | 18 | - | ns |
| | $t_{rr1}$ | $T_J$ = 25 °C | $I_F$ = 8.0 A<br>$dI_F/dt$ = 200 A/µs<br>$V_R$ = 200 V | - | 37 | 55 | |
| | $t_{rr2}$ | $T_J$ = 125 °C | | - | 55 | 90 | |
| Peak recovery current See fig. 7 and 8 | $I_{RRM1}$ | $T_J$ = 25 °C | | - | 3.5 | 5.0 | A |
| | $I_{RRM2}$ | $T_J$ = 125 °C | | - | 4.5 | 8.0 | |
| Reverse recovery charge See fig. 9 and 10 | $Q_{rr1}$ | $T_J$ = 25 °C | | - | 65 | 138 | nC |
| | $Q_{rr2}$ | $T_J$ = 125 °C | | - | 124 | 360 | |
| Peak rate of fall recovery current during $t_b$ See fig. 11 and 12 | $dI_{(rec)M}/dt1$ | $T_J$ = 25 °C | | - | 240 | - | A/µs |
| | $dI_{(rec)M}/dt2$ | $T_J$ = 125 °C | | - | 210 | - | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Lead temperature | $T_{lead}$ | 0.063" from case (1.6 mm) for 10 s | - | - | 300 | °C |
| Junction to case, single leg conducting | $R_{thJC}$ | | - | - | 3.5 | K/W |
| Junction to case, both leg conducting | | | - | - | 1.75 | |
| Thermal resistance, junction to ambient | $R_{thJA}$ | Typical socket mount | - | - | 40 | |
| Thermal resistance, case to heatsink | $R_{thCS}$ | Mounting surface, flat, smooth, and greased | - | 0.25 | - | |
| Weight | | | - | 6.0 | - | g |
| | | | - | 0.21 | - | oz. |
| Mounting torque | | | 6.0 (5.0) | - | 12 (10) | kgf · cm (lbf · in) |
| Marking device | | Case style TO-247AC 3L | HFA16PA60C | | | |

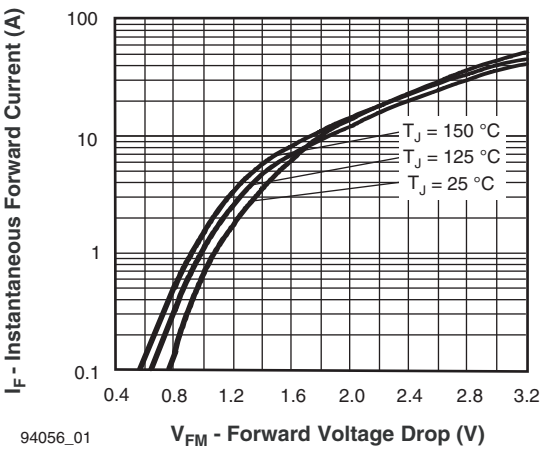



Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current (Per Leg)

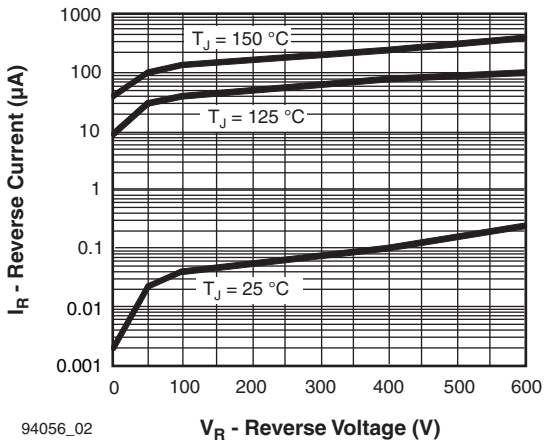



Fig. 2 - Typical Reverse Current vs. Reverse Voltage (Per Leg)

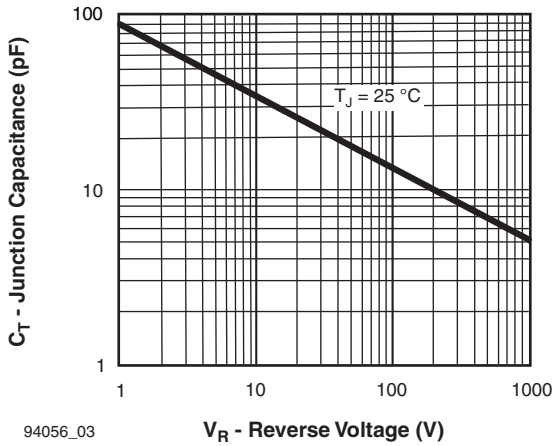



Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage (Per Leg)

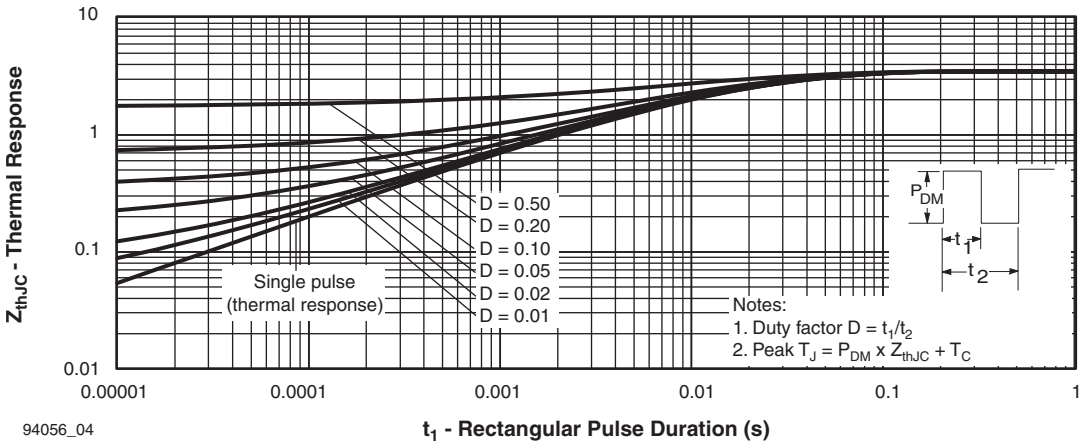



Fig. 4 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (Per Leg)

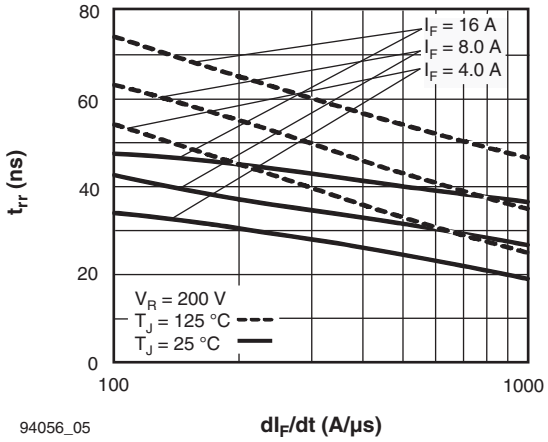



Fig. 5 - Typical Reverse Recovery Time vs. $dI_F/dt$ (Per Leg)

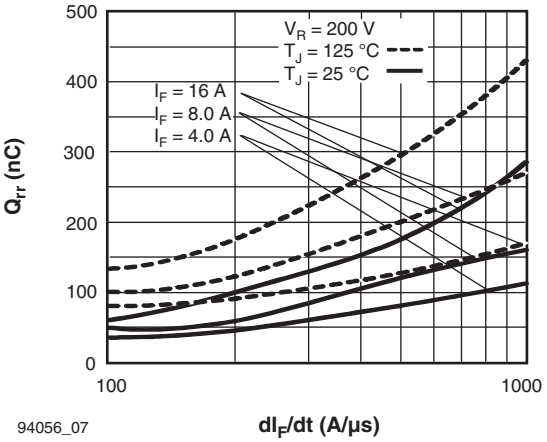



Fig. 7 - Typical Stored Charge vs. $dI_F/dt$ (Per Leg)

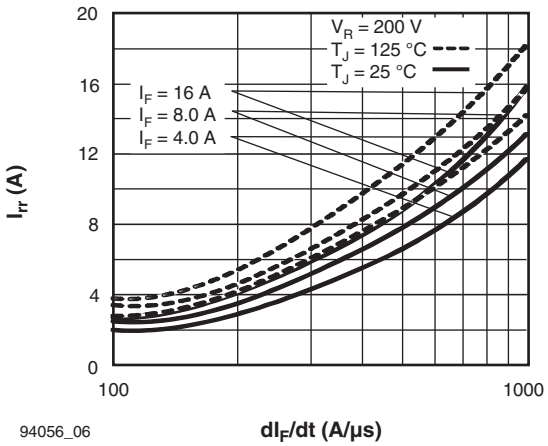



Fig. 6 - Typical Recovery Current vs. $dI_F/dt$ (Per Leg)

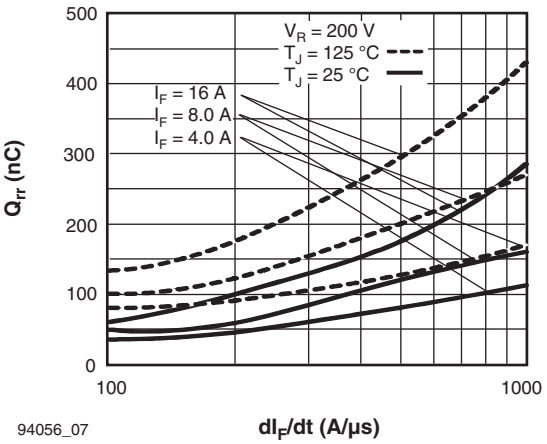
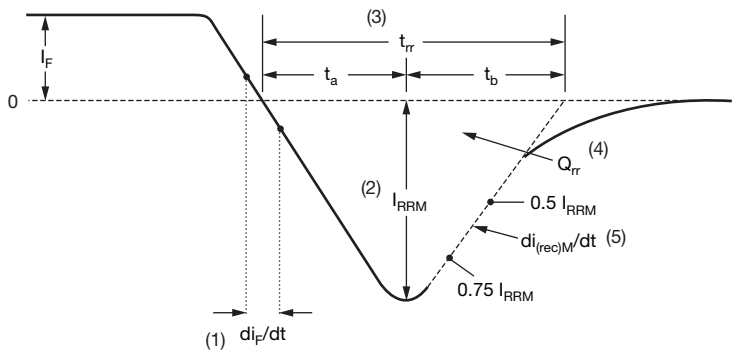



Fig. 8 - Typical $dI_{(rec)M}/dt$ vs. $dI_F/dt$ (Per Leg)




(1) $di_F/dt$ - rate of change of current through zero crossing

(2) $I_{RRM}$ - peak reverse recovery current

(3) $t_{rr}$ - reverse recovery time measured from zero crossing point of negative going $I_F$ to point where a line passing through 0.75 $I_{RRM}$ and 0.50 $I_{RRM}$ extrapolated to zero current.

(4) $Q_{rr}$ - area under curve defined by $t_{rr}$ and $I_{RRM}$

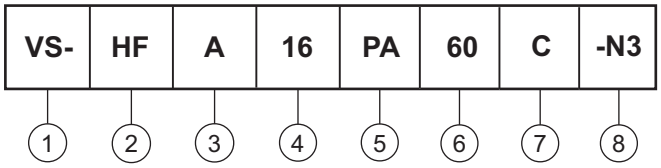
$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

(5) $di_{(rec)M}/dt$ - peak rate of change of current during $t_b$ portion of $t_{rr}$

Fig. 9 - Reverse Recovery Waveform and Definitions

## ORDERING INFORMATION TABLE

Device code



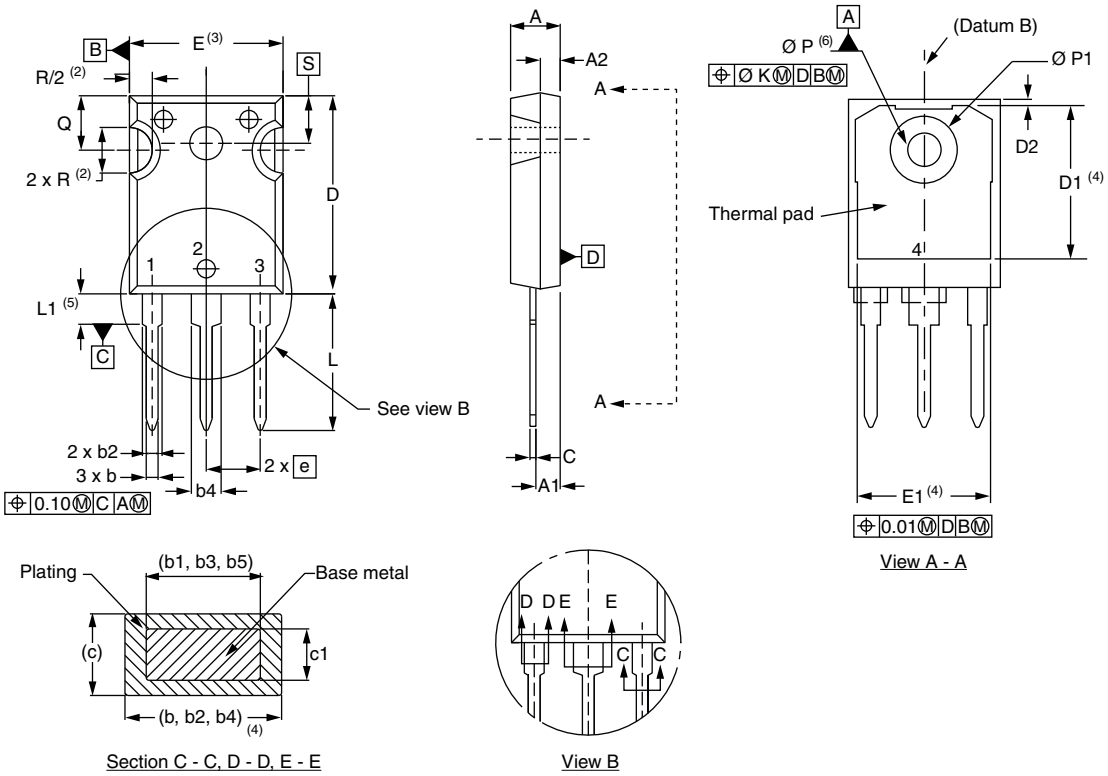

1 - Vishay Semiconductors product
2 - HEXFRED® family
3 - Electron irradiated
4 - Current rating (16 = 16 A)
5 - PA = TO-247AC, 3 pins
6 - Voltage rating: (60 = 600 V)
7 - Circuit configuration
C = common cathode
8 - Environmental digit:
-N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free

| **ORDERING INFORMATION** (Example) | | | |
|---|---|---|---|
| **PREFERRED P/N** | **QUANTITY PER T/R** | **MINIMUM ORDER QUANTITY** | **PACKAGING DESCRIPTION** |
| VS-HFA16PA60C-N3 | 25 | 500 | Antistatic plastic tube |

| **LINKS TO RELATED DOCUMENTS** | |
|---|---|
| Dimensions | www.vishay.com/doc?96138 |
| Part marking information | www.vishay.com/doc?95007 |
| SPICE model | www.vishay.com/doc?96596 |

# TO-247AC 3L

**DIMENSIONS** in millimeters and inches




| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.65 | 5.31 | 0.183 | 0.209 | |
| A1 | 2.21 | 2.59 | 0.087 | 0.102 | |
| A2 | 1.17 | 1.37 | 0.046 | 0.054 | |
| b | 0.99 | 1.40 | 0.039 | 0.055 | |
| b1 | 0.99 | 1.35 | 0.039 | 0.053 | |
| b2 | 1.65 | 2.39 | 0.065 | 0.094 | |
| b3 | 1.65 | 2.34 | 0.065 | 0.092 | |
| b4 | 2.59 | 3.43 | 0.102 | 0.135 | |
| b5 | 2.59 | 3.38 | 0.102 | 0.133 | |
| c | 0.38 | 0.89 | 0.015 | 0.035 | |
| c1 | 0.38 | 0.84 | 0.015 | 0.033 | |
| D | 19.71 | 20.70 | 0.776 | 0.815 | 3 |
| D1 | 13.08 | - | 0.515 | - | 4 |

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| D2 | 0.51 | 1.35 | 0.020 | 0.053 | |
| E | 15.29 | 15.87 | 0.602 | 0.625 | 3 |
| E1 | 13.46 | - | 0.53 | - | |
| e | 5.46 BSC | | 0.215 BSC | | |
| Ø K | 0.254 | | 0.010 | | |
| L | 14.20 | 16.10 | 0.559 | 0.634 | |
| L1 | 3.71 | 4.29 | 0.146 | 0.169 | |
| Ø P | 3.56 | 3.66 | 0.14 | 0.144 | |
| Ø P1 | - | 7.39 | - | 0.291 | |
| Q | 5.31 | 5.69 | 0.209 | 0.224 | |
| R | 4.52 | 5.49 | 0.178 | 0.216 | |
| S | 5.51 BSC | | 0.217 BSC | | |

**Notes**

(1) Dimensioning and tolerancing per ASME Y14.5M-1994

(2) Contour of slot optional

(3) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body

(4) Thermal pad contour optional with dimensions D1 and E1

(5) Lead finish uncontrolled in L1

(6) Ø P to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")

(7) Outline conforms to JEDEC® outline TO-247 with exception of dimension Q

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